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EERC Technology – Putting Research into Practice

Mercury Control Technology R&D Program Review

Pittsburgh, PA

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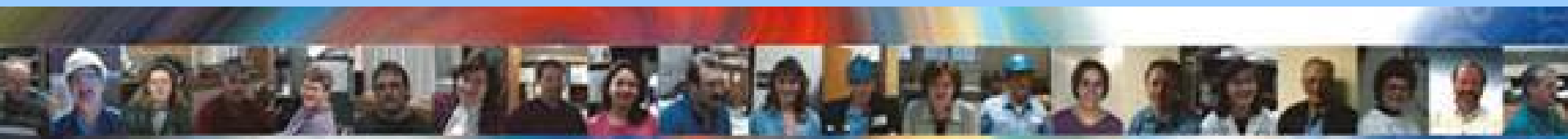

Acknowledgements

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Frontier Geosciences: Eric Prestbo
TVA: Ray Valente
Twin Otter

Project Goal

To gain an understanding of mercury chemistry as a plume moves downwind from the stack.

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Background

- Static Plume Dilution Chamber (Frontier Geosciences)
  - Full-scale testing
  - Pilot-scale testing
- Field Observations at Yorkville, GA
  - Atmospheric Research
  - Southern Company
  - EPA
- Plume Study at Bowen Power Plant
  - TVA
  - Frontier Geosciences
  - EERC

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Pleasant Prairie Power Plant

- Fuel type: Powder River Basin subbituminous coal
- Boiler capacity: two 617-MW units (Units 1 and 2)
- NO_x control: low-NO_x burners, SCR on Unit 2
- Particulate control: cold-side ESPs
- SO_2 control: low-sulfur coal

Twin Otter Flight and Sampling Crews

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Probe Detail

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Major Equipment in Plane

- Tekran automated mercury speciation system (113/1135 and 2537A)
  - Particulate-bound mercury, RGM, Hg^0
- NO_x analyzer modified for faster response time
- NO_x calibration unit
- Data acquisition (Hg, NO_x, GPS, time)

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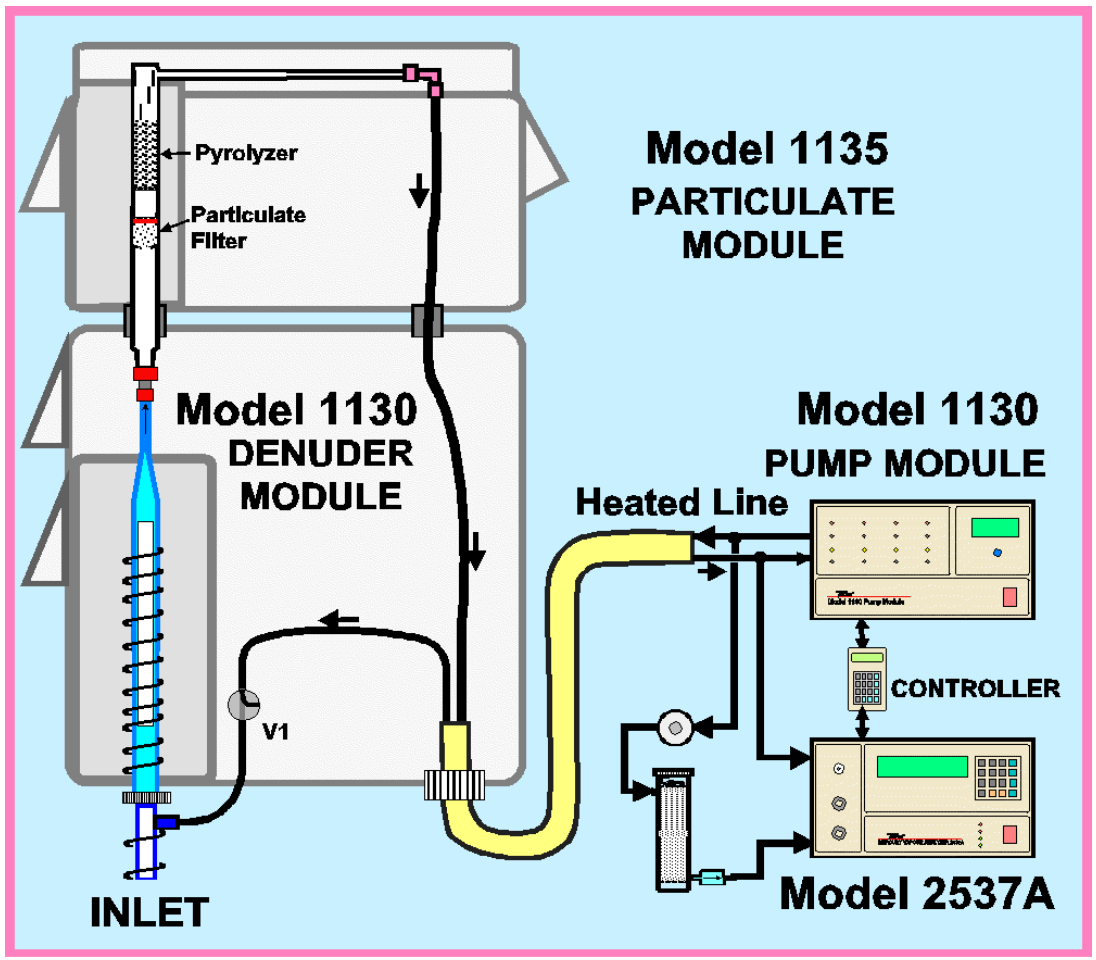
Diagram of the Tekran Automated Hg Analyzer



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Plume-Sampling Procedure (preflight)

- Synchronize computer clocks with GPS time
- Hg analyzer zeroed and spanned
- Primary injections used to span Hg analyzer
- NO_x analyzer zeroed and spanned

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Plume-Sampling Procedure (preflight), cont.

- 1130/1135 manually desorbed
- Sample zero gas for one cycle
- Sample ambient air for one cycle
- Switch to aircraft power

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Ground and Aerial View of the Stack at Pleasant Prairie

Plume-Sampling Procedure (in-flight)

- Sample approx. 5 miles upwind of stack for 25 minutes to determine background
- Find plume near plant while analyzing background sample
- Sample continuously at point close to stack for 25 minutes

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Plume-Sampling Procedure (in-flight), cont.

- Find plume approx. 5 miles downwind while analyzing first plume sample
- Set NO_x analyzer trigger point
- Sample 5 miles downwind of stack for 25 minutes
- Find plume 10 miles downwind of stack while analyzing second sample

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Plume-Sampling Procedure (in-flight), cont.

- Set NO_x analyzer trigger point
- Sample 10 miles downwind for 25 minutes
- Land while analyzing last sample
- Switch to ground power
- Desorb on zero air

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Flight Summary

- Sampling flight August 27
- Flooded probe with N_2 to demonstrate integrity of sampling system
- Background concentrations
  - Hg^0=2.0 ng/Nm^3 (N= 1 atm and 0°C)
  - Hg(p)=7.5 pg/Nm^3
  - RGM=9.8 pg/Nm^3
- Sampled near the stack, 5 and 10 miles downwind

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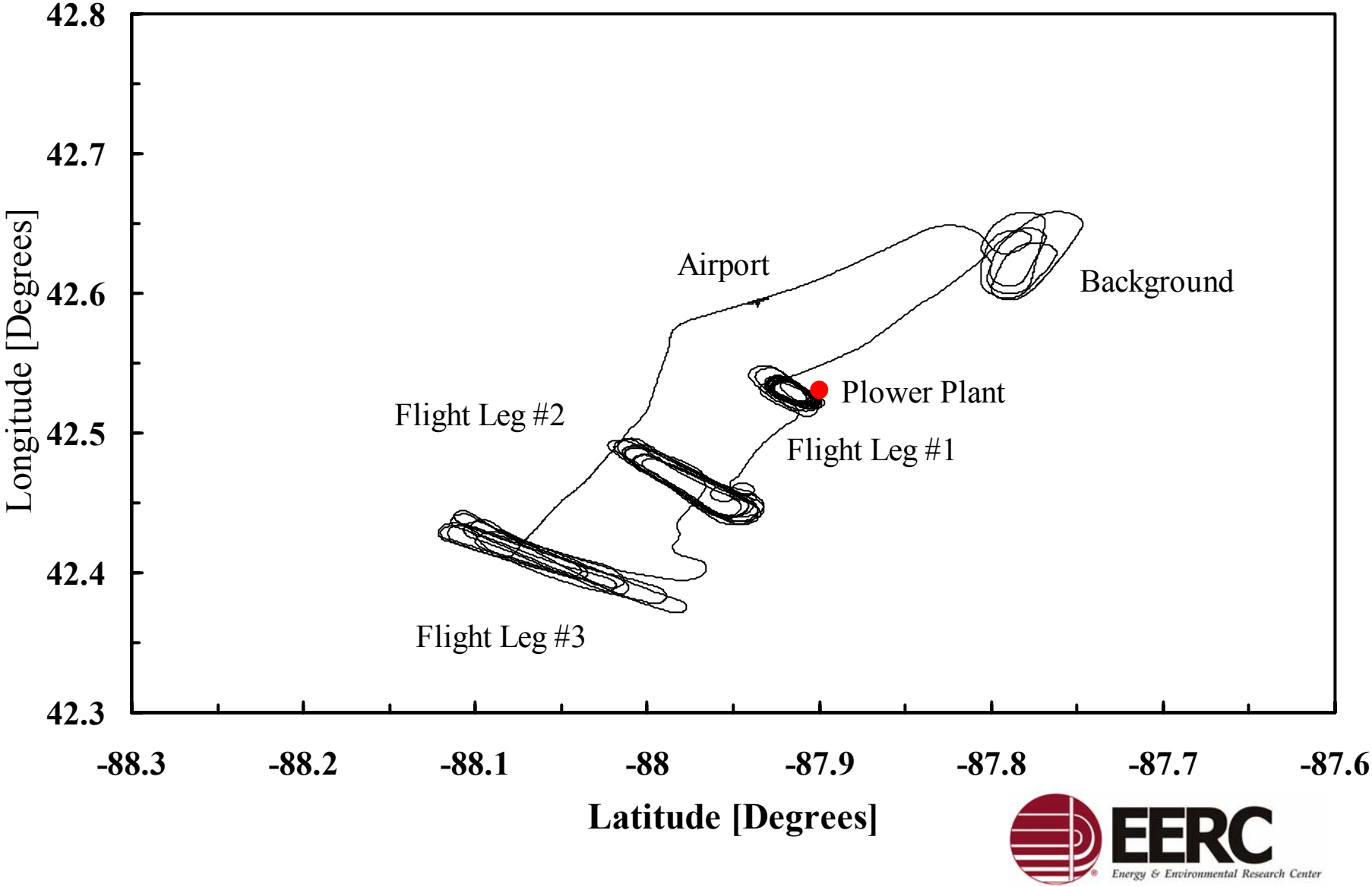
Flight Track on August 27, 2003



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Stack Sampling

- A Hg SCEM was located at the stack, measuring mercury continuously during each flight.
- Three Ontario Hydro samples were taken at the stack when the Hg SCEM was set up.
- One additional Ontario Hydro sample was taken each flight day.

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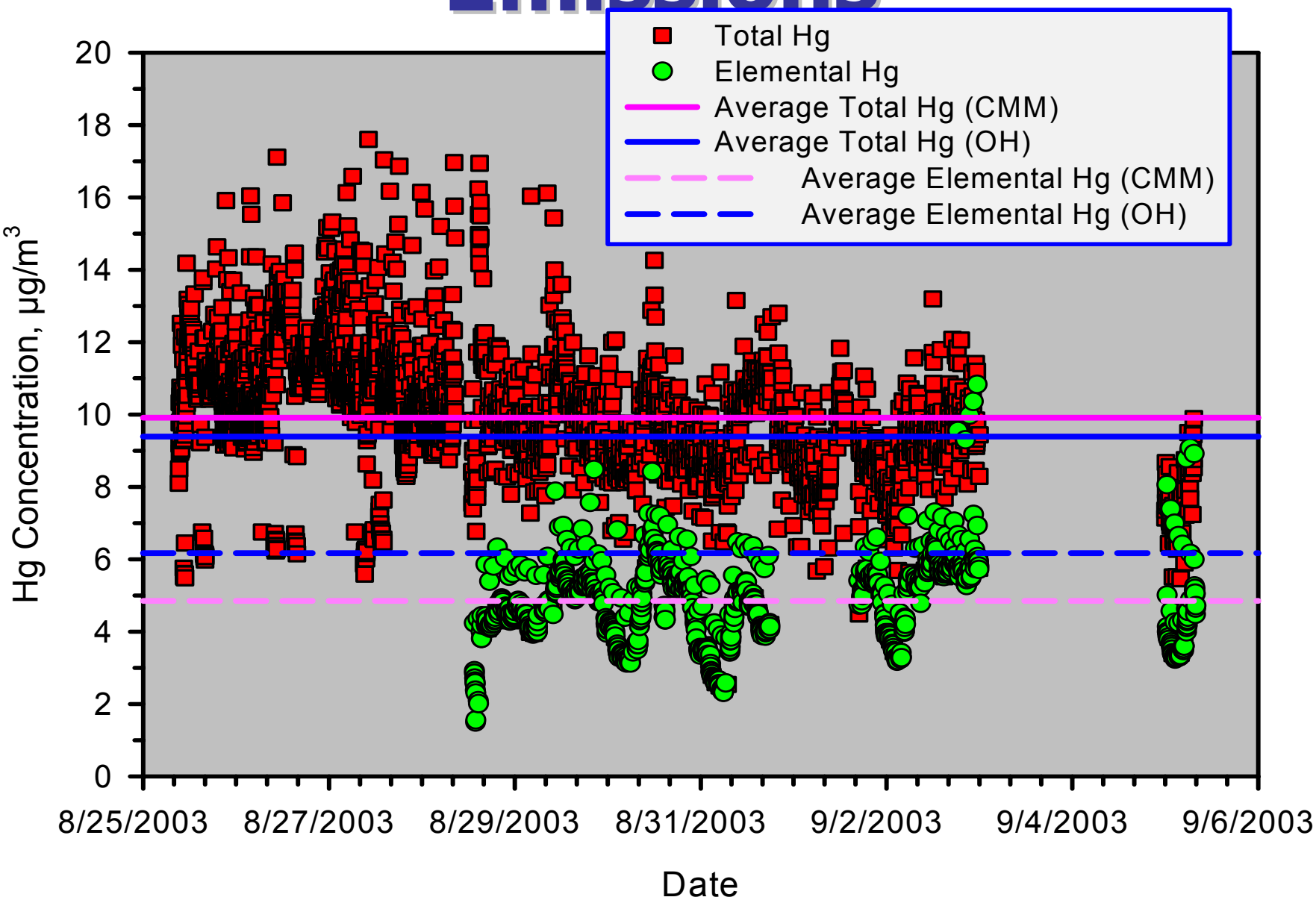
Pleasant Prairie Hg Emissions



Calculation of Dilution Ratios

$$DR = \frac{(\text{stack } NO_x \text{ - background } NO_x)}{(\text{plume } NO_x \text{ - background } NO_x)}$$

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Reasons for Outliers

- Low NO_x leads to very high dilution ratio.
  - May be caused by high zero valve trigger point.
  - "Skimming" the plume, which results in low NO_x concentrations.

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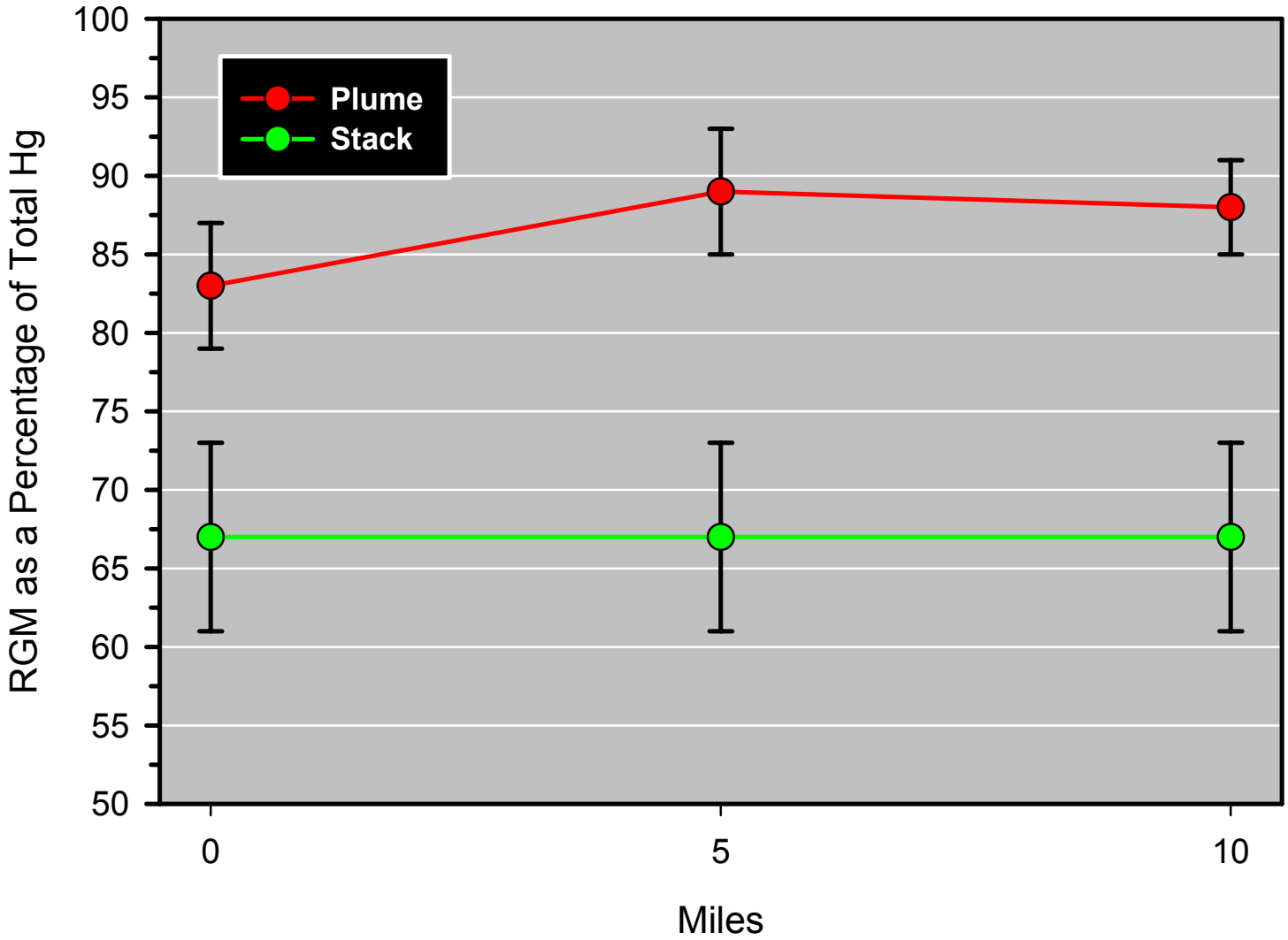
Total Hg Mass Balance: Plume Hg Compared to Stack Hg

0 Miles			5 Miles			10 Miles		
Total Hg in Plume, $\mu g/Nm^3$	Total Hg in Stack, $\mu g/Nm^3$	Bal., %	Total Hg in Plume, $\mu g/Nm^3$	Total Hg in Stack, $\mu g/Nm^3$	Bal., %	Total Hg in Plume, $\mu g/Nm^3$	Total Hg in Stack, $\mu g/Nm^3$	Bal., %
13.5	9.3	145	15.1	9.3	162	16.5	9.3	177
12.2	8.5	144	14.4	8.5	169	17.8	8.5	209
10.8	7.6	142	30.9	7.6	407	7.9	9.2	86
7.8	9.2	85	9.6	9.2	104			
12.0	9.2	130						
18.6	9.2	202						

Mercury Results

	0 Miles	5 Miles	10 Miles
Plume			
Hg^0	10.7	15.7	12.4
RGM	2.0	1.7	1.6
Total Hg	12.8	17.5	14.1
% Hg^0	83	89	88
Stack			
Hg^0	5.9	5.9	5.9
RGM	2.9	2.9	2.9
Total Hg	8.8	8.8	8.8
% Hg^0	67	67	67

Comparison of RGM in the Plume to the RGM in the Stack



Conclusions

- Mercury can be measured in plumes with reasonable accuracy.
- Using a dilution factor based on the plume and stack $NO_{x,}$ a reasonable mercury mass balance can be obtained when comparing the mercury in the stack to the mercury in the plume.
- There appears to be a reduction in RGM when comparing the RGM in the plume to the RGM in the stack (with a corresponding increase in Hg^0).
  - 44% reduction of RGM from the stack to first sample point
  - 66% reduction of RGM from stack to 5-mile sample point
  - No additional reduction after 5 miles

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